

PRELIMINARY REPORT ON THE FLORA PROJECT OF LA SELVA FIELD STATION, COSTA RICA¹

BARRY E. HAMMEL² AND MICHAEL H. GRAYUM³

ABSTRACT

Finca La Selva is an intensively studied biological field station with a poorly known flora. Presently we can account for about 1,500 species of vascular plants but the flora may contain as many as 2,000. Although collecting has been nearly continuous since the beginning of the project in the summer of 1979, we are still finding novelties. Experience at La Selva has driven home the fact that certain genera of both bulky and inaccessible plants have been habitually ignored by botanical collectors in the tropics. The wet Caribbean lowlands of Central America have themselves been relatively inaccessible and ignored. General collecting throughout the region is urgently needed.

HISTORY

Finca La Selva is a 730 hectare⁴ biological field station owned and operated by the Organization for Tropical Studies (OTS), which is a consortium of North and Central American universities. The station is located near the confluence of the Puerto Viejo and Sarapiquí rivers in the province of Heredia in the Caribbean lowlands of northeastern Costa Rica. The property encompasses about 650 hectares of primary forest in addition to 80 hectares of disturbed land, including old pasture, abandoned cacao and pejobaye (peach palm) plantations, 25-year-old successional woods, and regularly maintained one- through five-year-old successional plots. In the Holdridge Life Zone system, the vegetation is classified as Tropical Premontane Wet Forest (Holdridge et al., 1971). The average annual rainfall is about 3,900 mm. The elevation varies from 100 m along the Rio Puerto Viejo on the north edge of the property to 220 m in the ridge-dissected southern section (Petriceks, 1956). Thus, the altitudinal range from one end of the property to the other, a distance of about 3.4 km, exceeds that from the Caribbean coast to the La Selva field station, a distance of about 55 km.

For the last 12 years the station has been the annual site of as many as three OTS courses in tropical ecology as well as a number of courses offered by other institutions. The site has served almost continuously for the last 25 years as base for many researchers and has been particularly attractive to plant ecologists. A bibliography of published papers based on work done at La Selva contained about 200 entries by fall of 1981. Nevertheless, until recently fewer than half the species of vascular plants now known to occur at the station had been even tentatively identified or otherwise accounted for.

The need for a means to identify plants at La Selva has been ever-present. Standley's *Flora of Costa Rica* (1937–1938) is much out of date and provides only

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² Department of Botany, Duke University, Durham, North Carolina 27706.

³ Department of Botany, University of Massachusetts, Amherst, Massachusetts 01003.

⁴ The recently acquired and unexplored Vargas property nearly doubles the size of the station. It contains approximately equal areas of primary forest, secondary forest, and pasture.

an annotated list for most groups. Even the last more detailed part is inadequate for our area; it treats, for example, only 20 of the 32 species of *Psychotria* (Rubiaceae) known for La Selva. The Flora of Panama, published in the Annals of the Missouri Botanical Garden from 1943 to the present, and now completed, has been the most useful reference. However, most of the earlier treatments and many recent ones are nearly obsolete (Dressler, 1972; Gentry, 1978). Standley's treatment of the Araceae (1944) lists 31 species of *Anthurium* (taking synonymy into account), whereas over 150 are known from Panama today. The same treatment lists 12 species of *Philodendron*; there are over 75 known to date (T. B. Croat, personal communication). More than twice as many species of *Monstera*, *Syngonium*, and *Philodendron* are known from La Selva alone than were observed for all of Panama in 1944. For pteridophytes the situation is even more grim; only the excellent reference collection maintained by Luis Diego Gómez at the Museo Nacional in San José is of any help.

Support to initiate the Flora of La Selva project was obtained in 1979 from the U.S. National Science Foundation (NSF/DEB 79-04417). Since that time, intensive collecting by Jim Folsom (University of Texas), Michael Grayum (University of Massachusetts), Barry Hammel (Duke), John MacDougal (Duke), Damon Smith (Duke), John Sperry (Duke), Carol Todzia (University of Texas) and Robert L. Wilbur (Duke) has led to the accumulation of more than 10,000 collections. All unicates remain at Duke University, and replicates will be distributed among the Field Museum, Museo Nacional de Costa Rica, and the Missouri Botanical Garden. We are also maintaining a reference collection at La Selva. This on-site herbarium is essential during the collecting period and will be an aid to future users of the station for making final determinations, especially of sterile material.

Although a full-scale national Flora of Costa Rica is in progress (Burger, 1971) the Flora of La Selva is in no way redundant. The two projects are complementary and quite different. The fascicles of the Flora Costaricensis are an immense help to our work at La Selva. At the same time the thousands of specimens coming out of La Selva will help fill the extensive gap in knowledge of the flora of Costa Rica's Caribbean lowlands.

CURRENT WORK

Based on these and previous collections (ca. 2,000), particularly those of Gary Hartshorn (Tropical Science Center, Costa Rica) and Paul Opler (U.S. Department of the Interior), we are maintaining a card catalogue of taxa known from La Selva. At the beginning of the project the available checklist contained only 710 species. Up to the fall of 1980 the list was still growing at an average rate of about one new species per day. To date first approximation identifications have been made for about 850 of the estimated 1,500 species collected. Although intensive field work continues to reveal novelties almost weekly, by now, most additions to the flora represent rare individuals or isolated populations. Concentrated collecting efforts, especially in areas and times of year previously missed, could turn up as many as a hundred new records over the next year. This is an underestimate if we begin to explore the recently acquired Vargas property. Col-

TABLE 1. The ten most diverse families and genera of flowering plants known from La Selva field station, based on collections through September 1980.

Family	Number of Species	Genus	Number of Species
Araceae	97	<i>Piper</i> (Piperaceae)	46
Rubiaceae	85	<i>Psychotria</i> (Rubiaceae)	32
Orchidaceae	68	<i>Philodendron</i> (Araceae)	31
Piperaceae	66	<i>Anthurium</i> (Araceae)	27
Melastomataceae	56	<i>Miconia</i> (Melastomataceae)	18
Leguminosae	55	<i>Peperomia</i> (Piperaceae)	17
Gramineae	53	<i>Ficus</i> (Moraceae)	16
Moraceae	37	<i>Calathea</i> (Marantaceae)	14
Euphorbiaceae	33	<i>Passiflora</i> (Passifloraceae)	13
Compositae	32	<i>Monstera</i> (Araceae)	13

lecting is planned to continue through 1982. The current rate of discovery and identification illustrates the folly of publishing lists or keys to the plants of La Selva at this time. Nevertheless, enough information has accumulated for us to give an accounting of the ten most diverse families and genera (Table 1). Other genera with ten or more species at La Selva include *Clidemia* (Melastomataceae), *Clusia* (Guttiferae), *Drymonia* (Gesneriaceae), *Heliconia* (Heliconiaceae), *Inga* (Leguminosae), *Panicum* (Gramineae), *Pleurothallis* (Orchidaceae), and *Solanum* (Solanaceae).

By comparison, the somewhat drier and more seasonal moist forest of Barro Colorado Island (BCI), Panama, roughly twice the size of La Selva, contains approximately 1,369 taxa (including subspecies) of vascular plants (Croat, 1978). BCI has more species in certain groups (Table 2), such as Leguminosae, which tend to be more xerophilic. La Selva is comparatively richer in mesophilic elements such as epiphytes (e.g., Araceae) and vascular cryptogams. Of the latter, La Selva has about 165 species as compared with 104 on BCI. Only two genera (*Cyperus* and *Epidendrum*) with ten or more species at BCI are not also represented by ten or more species at La Selva. The La Selva flora, however, contains at least nine such genera not so diverse at BCI.

The forest of Río Palenque, Ecuador, however, which like La Selva is wet forest, contains 1,033 species of vascular plants (Dodson & Gentry, 1978). The Río Palenque site encompasses an area of just 1.7 km² with only 0.8 km² in natural forest. All but one genus (*Epidendrum*) of the eight genera at Río Palenque with ten or more species are also represented by ten or more species at La Selva.

Because of intensive collecting, the La Selva Flora project is producing a series of collections of numerous undescribed species and many rare or inaccessible species whose fruits or flowers had been poorly known elsewhere. These are essential to our own identification process but also should prove of great interest to biogeographers, systematists and ecologists at large. Discoveries of new species are of course exciting and interesting on their own; the description of taxa new to science discovered at La Selva as a result of the flora project is only beginning (e.g., Grayum & Hammel, 1982). Often, however, the identification of already described taxa yields much more information. For example, a number of our oddities (rare or unusual taxa that had until recently defied iden-

TABLE 2. The ten most diverse families and genera of flowering plants from Barro Colorado Island, Panama, based on Croat, 1978.

Family	Number of Species	Genus	Number of Species
Leguminosae	110	<i>Piper</i> (Piperaceae)	21
Orchidaceae	90	<i>Psychotria</i> (Rubiaceae)	20
Gramineae	77	<i>Inga</i> (Leguminosae)	18
Rubiaceae	67	<i>Ficus</i> (Moraceae)	17
Araceae	44	<i>Miconia</i> (Melastomataceae)	14
Compositae	42	<i>Philodendron</i> (Araceae)	13
Melastomataceae	35	<i>Epidendrum</i> (Orchidaceae)	13
Moraceae	34	<i>Anthurium</i> (Araceae)	12
Piperaceae	31	<i>Cyperus</i> (Cyperaceae)	11
Bignoniaceae	29	<i>Solanum</i> (Solanaceae)	11

tification) emphasize the affinities of wet lowland Costa Rica with northern South America (Table 3), and apparently represent new records for Costa Rica and Central America.

FUTURE WORK

Among the families listed in Table 1, the most likely to increase in numbers of species known with further collecting are Gramineae, Leguminosae, Moraceae, Rubiaceae, and especially Orchidaceae, which may ultimately come to surpass even the Araceae. We expect that most future additions to the list will come from these five families, along with rarities from among other families, particularly those containing large trees, shrubby epiphytes, lianas, or inconspicuous understory herbs. Groups that are at once hard to collect and diverse such as Araceae, Bromeliaceae, Orchidaceae, *Clusia*, and *Ficus* are the most problematic. Families with a predominantly vine or liana habit are exceedingly abundant and have presented particular challenges at La Selva. Most such families are poorly known throughout the tropics.

If there is one point that has been driven home repeatedly during the course of collecting for this project, it is the astounding gap that still remains between the prevailing knowledge of what the neotropical flora contains and what is actually present. Finca La Selva has for 25 years been one of the most intensively studied parcels of land on the Caribbean slope of Central America. Consider, then, that the checklist of La Selva plants available at the beginning of this project included only 19 species of Araceae, and just three species of *Philodendron*. Recently, an authority on Araceae was able to more than double this total during the course of a one-hour visit (T. B. Croat, personal communication). It is our opinion that the tree flora, although fairly well known, still harbors many new records. Certainly the greater part of the silva is known due to the collecting efforts of foresters. At La Selva most of the tree species were accounted for early on by Leslie Holdridge and Gary Hartshorn.

We are constantly reminded that specialists in particular groups and botanists spending relatively long periods in the field are those most likely to find novelties and discern differences. Before the initiation of this project, for example, just ten

TABLE 3. Known distributions of some recently identified plants from La Selva.

Species	Reported Previously from
<i>Amphidasya ambigua</i> Standl. (Rubiaceae)	Panama & Colombia (Dwyer, 1980)
<i>Asplundia antioquiae</i> Harling (Cyclanthaceae)	Colombia (Harling, 1958)
<i>Dicranostyles ampla</i> Ducke (Convolvulaceae)	Brazil, Guyana, Venezuela (Austin, 1973)
<i>Ferdinandusa panamensis</i> Standl. & L. O. Wms. (Rubiaceae)	Panama, genus otherwise S. Amer. (Dwyer, 1980)
<i>Moutabea</i> sp. (Polygalaceae)	Panama, genus otherwise S. Amer. (Lewis & Herrera-MacBryde, 1969)
<i>Psychotria microbotrys</i> Ruiz & Standl. (Rubiaceae)	Bolivia to Venezuela (Standley, 1936)
<i>Psychotria mima</i> Standl.	Panama, Colombia, Brazil (Dwyer, 1980)

species of *Calathea* (Marantaceae) were known to occur at La Selva, but until recently none of us had concentrated on that group. One week of careful search for and examination of *Calathea* resulted in the addition of four more species to the list.

SOME SPECIFIC CONSIDERATIONS

It has become almost axiomatic among tropical systematic botanists that, in the course of a taxonomic revision, one starts with a large batch of names and reduces them by at least 50% (Madison, 1977; Rojo, 1972). Although this is the natural result (and a major purpose of revision) in most cases, our extensive field experience in Costa Rica and Panama suggests that important diversity in certain genera will be obscured if species are merged indiscriminately. Such merging is partly a result of a lack of decent specimens, but more a result of the inadequacy of using only herbarium specimens to distinguish species in some tropical genera (e.g., *Clusia* and *Philodendron*). Taxonomic conservatism is also supported by a natural and justifiable reluctance to recognize species based on one or a few poor sheets. We all wish to avoid the creation of "artificial endemism" that results from provincial taxonomy (D'Arcy, 1977).

Descriptions of new species from the tropics, not in conjunction with revisionary or monographic work, have undoubtedly resulted in many redundant names. However in certain genera there are probably many more species that have gone undetected for lack of field studies than there are superfluous names that have been applied for lack of careful literature search. *Philodendron*, *Clusia*, and *Asplundia* (Cyclanthaceae) are diverse genera of often bulky and inaccessible plants that in any case make very poor herbarium specimens. In these groups there may actually be more species than names in southern Central America. We cannot overemphasize the necessity for intensive field studies to accompany revisionary work in such genera.

CONCLUSION

Although Costa Rica is one of the more well-collected tropical countries (Prance, 1978), the figures are actually rather deceptive. Much of the wet Carib-

bean slope even today is quite inaccessible. Human population density is higher on the seasonally dry Pacific side where clearing of land for crops and cattle farming has left almost no lowland forests. The lack of a distinct dry season in the Caribbean lowlands, more than any other factor, has resulted in fewer people, fewer roads, and more forests. To that extent botanists are like other people; they too, for the most part, have avoided the hot humid Caribbean lowland forests in preference to the drier Pacific slope and cooler mountains. It is ironic that these poorly known remaining forests might be among the most diverse in Central America, because they, too, will soon be gone (cf. D'Arcy, 1977).

The Sarapiquí-Puerto Viejo area, which includes Finca La Selva, has been singled out as one of four very diverse and poorly known areas most in need of further collecting in Costa Rica (Gentry, 1978). La Selva, however, is not unique among Central American forests because of its diversity. It is probably representative of the wet Caribbean lowlands from adjacent Nicaragua through Panama into northern South America. This area is particularly rich in groups that in general have been avoided or ignored by collectors, a fact that only compounds the need for further collecting and field studies in the region.

The Caribbean forests are disappearing at an alarming rate. Day after day trucks overloaded with giant logs climb the winding gravel road to San Jose. While efforts to preserve large tracts of tropical forests are sometimes promising, sometimes depressing, we must continue to sample this definitely endangered habitat.

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